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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/769,777	SUNG ET AL.	
	Examiner	Art Unit	
	KATRINA FUJITA	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 March 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,4,6-10,13,16-19,22,25-30,32,34-36,39,42-45,51-55 and 57* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3, 4, 6-10, 13, 16-19, 22, 25-30, 32, 34-36, 39, 42-45, 51-55 and 57* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This Office Action is responsive to Applicant's remarks received on March 10, 2009. Claims 1, 3, 4, 6-10, 13, 16-19, 22, 25-30, 32, 34-36, 39, 42-45, 51-55 and 57 remain pending.

Specification

2. The previous specification objection has been withdrawn in light of Applicant's amendment.

Claim Rejections - 35 USC § 101

3. The previous 101 rejections as pertaining to claims 25 and 26 are withdrawn in light of Applicant's amendment.

4. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The USPTO "Interim Guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility" (Official Gazette notice of 22 November 2005), Annex IV, reads as follows:

> In contrast, a claimed computer-readable medium encoded with a computer program is a computer element which defines structural and functional interrelationships between the computer program and the rest of the computer which permit the computer program's functionality to be realized, and is thus statutory. See Lowry, 32 F.3d at 1583-84, 32 USPQ2d at 1035.
>
> Claims that recite nothing but the physical characteristics of a form of energy, such as a frequency, voltage, or the strength of a magnetic field, define energy or magnetism, per se, and as such are nonstatutory natural phenomena. O'Reilly, 56 U.S. (15 How.) at 112-14. Moreover, it does not appear that a claim reciting a signal encoded with functional descriptive material falls within any of the categories of patentable subject matter set forth in Sec. 101.
>
> … a signal does not fall within one of the four statutory classes of Sec. 101.
>
> … signal claims are ineligible for patent protection because they do not fall within any of the four statutory classes of Sec. 101.

5. Claims 1, 3, 4, 6-10, 13, 16-19, 22, 51 and 57 are rejected under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention. Supreme Court precedent1[1] and recent Federal Circuit decisions[2] indicate that a statutory "process" under 35 U.S.C. 101 must (1) be tied to another statutory category (such as a particular apparatus), or (2) transform underlying subject matter (such as an article or material) to a different state or thing. While the instant claims recite a series of steps or acts to be performed, the claims neither transform underlying subject matter nor positively tie to another statutory category that accomplishes the claimed method steps, and therefore do not qualify as a statutory process. For example, claims 1 and 16 both recite steps of setting a plurality of splitting threshold values and setting a plurality of other splitting threshold values that are not described in the claims as being accomplished by an

[1] *Diamond v. Diehr*, 450 U.S. 175, 184 (1981); *Parker v. Flook*, 437 U.S. 584, 588 n.9 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 70 (1972); *Cochrane v. Deener*, 94 U.S. 780, 787-88 (1876).

apparatus or manufacture, nor do these steps transform subject matter from one state to another. Similarly, claim 51 recites steps of splitting macro image blocks and splitting each sub block that are not accomplished by an apparatus or manufacture, nor do these steps transform subject matter from one state to another.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1, 3, 10, 13, 16, 19, 22, 25-29, 36, 39, 42, 45, 48, 51, 52 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Mancini et al. ("Robust quadtree-based disparity estimation…", SPIE article), Thyagarajan et al. (US 6,529,634) and Pullen et al. (US 5,923,376).

Regarding **claim 1**, Mancini et al. discloses a method of splitting an image block ("identify problematic blocks…and then split them" at section 6.5, paragraph 2, line 1) comprising:

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[2] *In re Bilski*, 88 USPQ2d 1385 (Fed. Cir. 2008).

setting a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) with a macro block splitting determining unit (portion of the apparatus that performs the algorithm) to compare with a characteristic ("average absolute DPD" at section 6.5.1, paragraph 3, line 10; "number of outliers" at section 6.5.1, paragraph 3, line 11; "ratio of the maximum to the minimum number of outliers" at section 6.5.1, paragraph 3, line 13) of a macro block ("block B_{ij}" at section 6.5.1, paragraph 3, line 4) in an image frame and determining thereby whether to split the macro block into sub blocks ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6) with the macro block splitting determining unit;

setting a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) with a sub block splitting determining unit (portion of the apparatus that performs the step of the algorithm) to compare with a characteristic ("average absolute DPD" at section 6.5.1, paragraph 3, line 10; "number of outliers" at section 6.5.1, paragraph 3, line 11; "ratio of the maximum to the minimum number of outliers" at section 6.5.1, paragraph 3, line 13) of each sub block and determining thereby whether to split each sub block into smaller sub blocks ("Sub-blocks that will still fall on object boundaries can undergo further splitting" at section 6.5, paragraph 2, line 5).

Mancini et al. does not disclose that the plurality of splitting threshold values for each sub block is different than the plurality of splitting threshold values for a macroblock.

Thyagarajan et al. teaches a method of splitting an image block ("decision to subdivide a block" at col. 5, line 57) comprising:

setting a plurality of splitting threshold values to compare with a characteristic of a macro block in an image frame ("threshold T16 is modified to provide a new threshold T'16 if the mean value of the block is between two predetermined values" at col. 6, line 1) with a macro block splitting determining unit (figure 2, numeral 206); and

setting a plurality of other splitting threshold values to compare with a characteristic of each sub block ("variance threshold T8 is modified to provide a new threshold T'8 if the mean value of the block is between two predetermined values" at col. 6, line 16) with a sub block splitting determining unit (figure 2, numeral 216).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize a different splitting threshold for the sub block from the macroblock as taught by Thyagarajan et al. to define the splitting thresholds of Mancini et al. to ensure that "small blocks are assigned even in relatively dark areas" (Thyagarajan et al. at col. 9, line 30) and to preserve "details in all areas that are above just noticeable visibility threshold" (Thyagarajan et al. at col. 9, line 31).

The Mancini et al. and Thyagarajan et al. combination does not disclose determining whether a macro block at a same location in a preceding image frame has been split.

Pullen et al. teaches a method of splitting an image block ("segmenting the screen components for the data in each frame buffer into blocks" at col. 11, line 2) comprising:

determining whether to split the block by determining whether a block at a same location in a preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the macro blocks of the Mancini et al. and Thyagarajan et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 16**, Mancini et al. discloses a method of splitting an image block ("identify problematic blocks…and then split them" at section 6.5, paragraph 2, line 1) comprising:

setting a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) to compare with a characteristic ("average absolute DPD" at section 6.5.1, paragraph 3, line 10; "number of outliers" at section 6.5.1, paragraph 3, line 11; "ratio of the maximum to the minimum number of

outliers" at section 6.5.1, paragraph 3, line 13) of a macro block ("block B_{ij}" at section 6.5.1, paragraph 3, line 4) in an image frame and determining thereby whether to split the macro block into sub blocks ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6) with a macro block splitting determining unit (portion of the apparatus that performs the algorithm);

setting a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) to compare with a characteristic ("average absolute DPD" at section 6.5.1, paragraph 3, line 10; "number of outliers" at section 6.5.1, paragraph 3, line 11; "ratio of the maximum to the minimum number of outliers" at section 6.5.1, paragraph 3, line 13) of each sub block and determining thereby whether to split each sub block into smaller sub blocks ("Sub-blocks that will still fall on object boundaries can undergo further splitting" at section 6.5, paragraph 2, line 5) with a sub block splitting determining unit (portion of the apparatus that performs the algorithm).

Mancini et al. does not disclose that the plurality of splitting threshold values for each sub block is different than the plurality of splitting threshold values for a macroblock.

Thyagarajan et al. teaches a method of splitting an image block ("decision to subdivide a block" at col. 5, line 57) comprising:

setting a plurality of splitting threshold values to compare with a characteristic of a macro block in an image frame ("threshold T16 is modified to provide a new threshold

T'16 if the mean value of the block is between two predetermined values" at col. 6, line 1) with a macro block splitting determining unit (figure 2, numeral 206); and

setting a plurality of other splitting threshold values to compare with a characteristic of each sub block ("variance threshold T8 is modified to provide a new threshold T'8 if the mean value of the block is between two predetermined values" at col. 6, line 16) with a sub block splitting determining unit (figure 2, numeral 216).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize a different splitting threshold for the sub block from the macroblock as taught by Thyagarajan et al. to define the splitting thresholds of Mancini et al. to ensure that "small blocks are assigned even in relatively dark areas" (Thyagarajan et al. at col. 9, line 30) and to preserve "details in all areas that are above just noticeable visibility threshold" (Thyagarajan et al. at col. 9, line 31).

The Mancini et al. and Thyagarajan et al. combination does not disclose determining whether a macro block at a same location in a preceding image frame has been split and determining whether a sub block at a same location in a preceding image frame has been split.

Pullen et al. teaches a method of splitting an image block ("segmenting the screen components for the data in each frame buffer into blocks" at col. 11, line 2) comprising:

determining whether to split the macro block by determining whether a macro block at a same location in a preceding image frame has been split ("find a block in

previous buffer 30, a search corresponds to a block in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the macro blocks of the Mancini et al. and Thyagarajan et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 25**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a computer-readable medium having computer readable-codes recorded thereon that, when executed by a computer (it is inherent that the method is written on a computer-readable medium to enable the method to performed), perform the method as described by claim 1 above (see claim 1 rejection).

Regarding **claim 26**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a computer-readable medium having computer readable-codes recorded thereon that, when executed by a computer (it is inherent that the method is written on a recording medium to enable the method to performed) perform the method as described in the rejection of claim 16 above (see claim 16 rejection).

Regarding **claim 27**, Mancini et al. discloses an apparatus (an apparatus is inherent to carry out the function of the method) to split an image block ("identify problematic blocks…and then split them" at section 6.5, paragraph 2, line 1) comprising:

a macro block splitting determining unit (portion the apparatus that performs the steps of the algorithm) that sets a plurality of splitting threshold values for splitting a macro block in an image frame into sub blocks ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) and determines therewith whether to split the macro block ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6);

a sub block splitting determining unit (portion the apparatus that performs the steps of the algorithm) that sets a plurality of sub block splitting threshold values for splitting each sub block into smaller sub blocks ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) and determines therewith whether to split each sub block ("Sub-blocks that will still fall on object boundaries can undergo further splitting" at section 6.5, paragraph 2, line 5).

Mancini et al. does not disclose that the plurality of splitting threshold values for each sub block is different than the plurality of splitting threshold values for a macroblock.

Thyagarajan et al. teaches an apparatus ("system or apparatus and method of image compression" at col. 3, line 50) to split an image block ("decision to subdivide a block" at col. 5, line 57) comprising:

a macro block splitting determining unit (figure 2, numeral 206) that sets a plurality of splitting threshold values for splitting a macro block in an image frame into sub blocks (“threshold T16 is modified to provide a new threshold T’16 if the mean value of the block is between two predetermined values” at col. 6, line 1); and

a sub block splitting determining unit (figure 2, numeral 216) that sets a splitting threshold value to compare with a characteristic of each sub block (“variance threshold T8 is modified to provide a new threshold T’8 if the mean value of the block is between two predetermined values” at col. 6, line 16).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize a different splitting threshold for the sub block from the macroblock as taught by Thyagarajan et al. to define the splitting thresholds of Mancini et al. to ensure that "small blocks are assigned even in relatively dark areas" (Thyagarajan et al. at col. 9, line 30) and to preserve “details in all areas that are above just noticeable visibility threshold” (Thyagarajan et al. at col. 9, line 31).

The Mancini et al. and Thyagarajan et al. combination does not disclose determining whether a macro block at a same location in a preceding image frame has been split.

Pullen et al. teaches an apparatus to split an image block ("segmenting the screen components for the data in each frame buffer into blocks” at col. 11, line 2) comprising:

a macro block splitting determining unit (figure 2) that determines therewith whether to split the block by determining whether a block at a same location in a preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the macro blocks of the Mancini et al. and Thyagarajan et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 42**, Mancini et al. discloses an apparatus (an apparatus is inherent to carry out the function of the method) to split an image block ("identify problematic blocks…and then split them" at section 6.5, paragraph 2, line 1) comprising:

a macro block splitting determining unit (portion the apparatus that performs the steps of the algorithm) that sets a plurality of splitting threshold values for splitting a macro block in an image frame into sub blocks ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) and determines whether to split the macro block ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6);

a sub block splitting determining unit (portion the apparatus that performs the steps of the algorithm) that sets a plurality of sub block splitting threshold values for splitting each sub block into smaller sub blocks ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) and determines whether to split each sub block ("Sub-blocks that will still fall on object boundaries can undergo further splitting" at section 6.5, paragraph 2, line 5).

Mancini et al. does not disclose that the plurality of splitting threshold values for each sub block is different than the plurality of splitting threshold values for a macroblock.

Thyagarajan et al. teaches an apparatus ("system or apparatus and method of image compression" at col. 3, line 50) to split an image block ("decision to subdivide a block" at col. 5, line 57) comprising:

a macro block splitting determining unit (figure 2, numeral 206) that sets a plurality of splitting threshold values to compare with a characteristic of a macro block in an image frame ("threshold T16 is modified to provide a new threshold T'16 if the mean value of the block is between two predetermined values" at col. 6, line 1); and

a sub block splitting determining unit (figure 2, numeral 216) that sets a splitting threshold value to compare with a characteristic of each sub block ("variance threshold T8 is modified to provide a new threshold T'8 if the mean value of the block is between two predetermined values" at col. 6, line 16).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize a different splitting threshold for the sub block from the macroblock as taught by Thyagarajan et al. to define the splitting thresholds of Mancini et al. to ensure that "small blocks are assigned even in relatively dark areas" (Thyagarajan et al. at col. 9, line 30) and to preserve “details in all areas that are above just noticeable visibility threshold” (Thyagarajan et al. at col. 9, line 31).

The Mancini et al. and Thyagarajan et al. combination does not disclose determining whether a macro block at a same location in a preceding image frame has been split and determining whether the sub block at a same location in the preceding image frame has been split.

Pullen et al. teaches an apparatus to split an image block ("segmenting the screen components for the data in each frame buffer into blocks” at col. 11, line 2) comprising:

a macro block splitting determining unit (figure 2) that determines therewith whether to split the macro block by determining whether a macro block at a same location in a preceding image frame has been split (“find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16” at col. 12, line 14; “process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks” at col. 18, line 4; “If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the

domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30); and

a sub block splitting determining unit that determines whether to split each sub block by determining whether the sub block at a same location in the preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold" at col. 5, line 55).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the blocks of the Mancini et al. and Thyagarajan et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 51**, Mancini et al. discloses a method of splitting a block comprising:

splitting macro image blocks ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6) each of left-eye views and right eye views ("stereoscopic test images" at section 6.5, paragraph 1, line 2) into sub image blocks ("split them into four equal-sized sub-blocks" at section 6.5, paragraph 2, line 1) according to quadtree disparity estimation ("Quadtree disparity estimation" at section 6.5) using a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) with a macro block splitting determining unit (portion of the apparatus that performs the algorithm) and splitting each sub block into smaller sub blocks ("Sub-blocks that will still fall on object boundaries can

undergo further splitting" at section 6.5, paragraph 2, line 5) according to quadtree disparity estimation ("Quadtree disparity estimation" at section 6.5) using a plurality of splitting threshold values ("The steps above rely on three threshold values" at section 6.5.1, paragraph 3, line 10) with a sub block splitting determining unit (portion of the apparatus that performs the algorithm).

Mancini et al. does not disclose that the plurality of splitting threshold values for each sub block is different than the plurality of splitting threshold values for a macroblock.

Thyagarajan et al. teaches a method of splitting an image block ("decision to subdivide a block" at col. 5, line 57) comprising:

splitting macro image blocks into sub image blocks ("subdivided into four 8x8 blocks" at col. 6, line 12) using a plurality of splitting threshold values ("threshold T16 is modified to provide a new threshold T'16 if the mean value of the block is between two predetermined values" at col. 6, line 1) with a macro block splitting determining unit (figure 2, numeral 206); and

splitting each sub block into smaller sub blocks ("8x8 block is to be subdivided into four 4x4 blocks" at col. 6, line 25) using a plurality of other splitting threshold values ("variance threshold T8 is modified to provide a new threshold T'8 if the mean value of the block is between two predetermined values" at col. 6, line 16) with a sub block splitting determining unit (figure 2, numeral 216).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize a different splitting threshold for the sub block from the macroblock as taught by Thyagarajan et al. to define the splitting thresholds of Mancini et al. to ensure that "small blocks are assigned even in relatively dark areas" (Thyagarajan et al. at col. 9, line 30) and to preserve “details in all areas that are above just noticeable visibility threshold” (Thyagarajan et al. at col. 9, line 31).

The Mancini et al. and Thyagarajan et al. combination does not disclose determining not to split the macro block if the macro block at a same location in a preceding image frame has not been split.

Pullen et al. teaches a method of splitting an image block ("segmenting the screen components for the data in each frame buffer into blocks” at col. 11, line 2) comprising:

determining not to split the macro block if the macro block at a same location in a preceding image frame has not been split (“find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16” at col. 12, line 14; “process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks” at col. 18, line 4; “If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block” at col. 18, line 30; if the estimated cost is more than the distortion

measurement, then the level 1 search is not performed hence not splitting the level 0 block).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the macro blocks of the Mancini et al. and Thyagarajan et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 3**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses the elements of claim 1 as described above.

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not disclose that the determining of whether to split each sub block into smaller sub blocks is performed by determining whether the sub block at the same location in a preceding image frame has been split.

Pullen et al. teaches a method wherein the determining of whether to split each sub block into smaller sub blocks is performed by determining whether the sub block at the same location in a preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold" at col. 5, line 55).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the blocks of the Mancini et al., Thyagarajan et al. and Pullen et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

Regarding **claim 10**, Mancini et al. discloses a method wherein the image frame is a binocular image frame ("intermediate image I_I (Fig. 1) from the left-right image pair" at section 2, paragraph 2, line 4) representing a three dimensional image ("the '3D-ness' of the data" at section 1, paragraph 1, line 9).

Regarding **claim 13**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method further comprising:

splitting the macro image block ("determine whether block B_{ij} requires splitting" Mancini et al. at section 6.5.1, paragraph 3, line 6) according to the determining by comparison with the thresholds and the other thresholds (steps of the algorithm in section 6.5.1) into sub image blocks ("split them into four equal-sized sub-blocks" Mancini et al. at section 6.5, paragraph 2, line 1) and into smaller sub blocks ("Sub-blocks that will still fall on object boundaries can undergo further splitting" Mancini et al. at section 6.5, paragraph 2, line 5) according to quadtree disparity estimation ("Quadtree disparity estimation" Mancini et al. at section 6.5).

Regarding **claims 19 and 45**, Mancini et al. discloses a method and apparatus wherein the image frame is a binocular image frame ("intermediate image I_I (Fig. 1) from the left-right image pair" at section 2, paragraph 2, line 4) representing a three dimensional image ("the '3D-ness' of the data" at section 1, paragraph 1, line 9).

Regarding **claim 22**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method further comprising:

splitting the macro block according to the determining of whether the macro block and sub blocks at respective same locations in the preceding image frame have been

split ("the image element in the first block of the present frame is compared with the image element of the first block of the preceding frame with the position of the image element and block of the present frame being the same as those of the preceding frame, thereby determining whether the first block of the present frame is a valid block in which the image is different from that in the first block of the preceding frame" Murashita et al. at col. 12, line 48) using quadtree disparity estimation ("Quadtree disparity estimation" Mancini et al. at section 6.5).

Regarding **claim 28**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses an apparatus (an apparatus is inherent to carry out the function of the method) that performs the method as described in the rejection of claim 1 above.

Regarding **claim 29**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses an apparatus (an apparatus is inherent to carry out the function of the method) that performs the method as described in the rejection of claim 3 above.

Regarding **claim 36**, Mancini et al. discloses an apparatus wherein the image frame is a binocular image frame ("intermediate image I_I (Fig. 1) from the left-right image pair" at section 2, paragraph 2, line 4) representing a three dimensional image ("the '3D-ness' of the data" at section 1, paragraph 1, line 9).

Regarding **claim 39**, Mancini et al. discloses an apparatus wherein splitting of the macro block ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6) and the sub block ("split them into four equal-sized sub-blocks" at section 6.5, paragraph 2, line 1) is performed using quadtree disparity estimation ("Quadtree disparity estimation" at section 6.5).

Regarding **claim 48**, Mancini et al. discloses an apparatus wherein splitting of the macro block ("determine whether block B_{ij} requires splitting" at section 6.5.1, paragraph 3, line 6) and the sub block ("split them into four equal-sized sub-blocks" at section 6.5, paragraph 2, line 1) is performed using quadtree disparity estimation ("Quadtree disparity estimation" at section 6.5).

Regarding **claim 52**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a computer-readable medium having computer readable-codes that, when executed (it is inherent that the method is written on a recording medium to enable the method to performed) perform the method as described in the rejection of claim 3 above.

Regarding **claim 57**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses the elements of claim 51 as described above.

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not disclose determining not to split the sub block if the sub block at a same location in a preceding frame has not been split.

Pullen et al. teaches a method comprising determining not to split the sub block if the sub block at a same location in a preceding frame has not been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold. If it is greater than or equal to the threshold, no further processing of the domain child block is performed" at col. 5, line 55).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the block comparison of Pullen et al. on the blocks of the Mancini et al., Thyagarajan et al. and Pullen et al. combination as it "reduces the number of searches required to compress a data set" (Pullen et al. at col. 2, line 59).

8. Claims 4, 6-9, 17, 18, 30, 32, 34, 35, 43, 44 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Mancini et al., Thyagarajan et al. and Pullen et al. as applied to claims 1 and 27 above, and further in view of Boyce (US 5,208,673).

Regarding **claim 4**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method of splitting a block wherein the determining whether to split the macro block into sub blocks comprises:

determining a possibility of splitting a macro block ("determine whether block B_{ij} requires splitting" Mancini et al. at section 6.5.1, paragraph 3, line 6) by determining whether the ratio of maximum mean absolute difference (MAD) to minimum MAD of a sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the set splitting threshold values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block; and

determining whether to split the macro block by comparing the threshold value for determining the possibility of splitting the macro block ("Threshold θ_2" Mancini et al. at section 6.5.1, paragraph 3, line 11), and comparing the ratio of maximum MAD to minimum MAD, and a threshold value for determining whether to split the macro block with one another ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13), if a ratio is greater than the threshold for determining the possibility of splitting the macro block ("if $\Sigma \kappa_i < \theta_2$ then do not split, otherwise continue" Mancini et al. at section 6.5.1, paragraph 3, line 8; "tolerable number of outliers as a fraction of the block size" Mancini et al. at section 6.5.1, paragraph 3, line 11),

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach comparing the threshold value for determining the possibility of splitting the macro block with the ratio of maximum MAD to minimum MAD, and that the ratio greater than the threshold for determining the possibility of splitting the macro block is the ratio of maximum MAD to minimum MAD.

Boyce discloses a method comprising:

comparing the threshold value for determining the possibility of splitting the macro block ("determined value B" at col. 4, line 44) with the ratio ("ratio of MAD_o /MAD_{min}" at col. 4, line 56) of maximum MAD ("MAD_o is the mean of the absolute differences between pixels in the block in a reference frame for which noise is to be reduced and the pixels in a block having the same position in another frame" at col. 4,

line 28) to minimum MAD ("The matching block is the one having the minimum value of mean absolute difference, MAD, which is MAD_{min}" at col. 4, line 34),

the ratio greater than the threshold for determining the possibility of splitting the macro block is the ratio of maximum MAD to minimum MAD ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 6**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method of splitting a block wherein the determining of whether to split each sub block into smaller sub blocks comprises:

determining a possibility of splitting a sub block ("determine whether block B_{ij} requires splitting" Mancini et al. at section 6.5.1, paragraph 3, line 6) by determining whether a ratio of maximum mean absolute difference (MAD) to minimum MAD of the smaller sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) is greater than a threshold value from among the other set splitting threshold values ("threshold value

θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the sub block; and

determining whether to split the sub block by determining whether a ratio is greater than the threshold for determining the possibility of splitting the sub block ("if $\Sigma \kappa_i < \theta_2$ then do not split, otherwise continue" Mancini et al. at section 6.5.1, paragraph 3, line 8; "tolerable number of outliers as a fraction of the block size" Mancini et al. at section 6.5.1, paragraph 3, line 11),

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach that the ratio greater than the threshold for determining the possibility of splitting the sub block is the ratio of maximum MAD to minimum MAD.

Boyce discloses a method comprising:

the ratio greater than the threshold for determining the possibility of splitting the sub block is the ratio of maximum MAD to minimum MAD ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 7**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method of splitting a block wherein the determining of whether to split each sub block into smaller sub blocks comprises:

determining a possibility of splitting the sub block ("determine whether block B_{ij} requires splitting", Mancini et al. at section 6.5.1, paragraph 3, line 6) by determining whether a ratio of maximum mean absolute difference (MAD) to minimum MAD of a sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the set other splitting threshold values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block; and

determining whether to split the sub block by determining whether a ratio is greater than the threshold for determining the possibility of splitting the sub block ("if $\Sigma \kappa_i < \theta_2$ then do not split, otherwise continue" Mancini et al. at section 6.5.1, paragraph 3, line 8; "tolerable number of outliers as a fraction of the block size" Mancini et al. at section 6.5.1, paragraph 3, line 11),

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach that the ratio greater than the threshold for determining the possibility of splitting the macro block is the ratio of maximum MAD to minimum MAD.

Boyce discloses a method comprising:

the ratio greater than the threshold for determining the possibility of splitting the sub block is the ratio of maximum MAD to minimum MAD ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 17**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method wherein determining whether to split the macro block according to whether a macro block has been split in a preceding image frame at the same location comprises:

determining a possibility of splitting the macro block ("determine whether block B_{ij} requires splitting" Mancini et al. at section 6.5.1, paragraph 3, line 6) by determining whether a ratio of maximum mean absolute difference (MAD) to minimum MAD of a sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the set macro block splitting threshold

values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block,

determining whether the ratio of maximum of maximum MAD to minimum MAD is less than the threshold value for determining whether to split the macro block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13),

determining whether the macro block at the same location in the preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" Pullen et al. at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" Pullen et al. at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" Pullen et al. at col. 18, line 30) if the ratio is less than the threshold value for determining whether to split the macro block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9),

determining not to split the macro block if the macro block at the same location in the preceding image frame has not been split and determining to split the macro block if the macro block at the same location in the preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" Pullen et al. at col. 12, line 14; "process for level 1 begins by segmenting the level 0

domain block in to a plurality of level 1 domain child blocks" Pullen et al. at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" Pullen et al. at col. 18, line 30; if the estimated cost is more than the distortion measurement, then the level 1 search is not performed hence not splitting the level 0 block).

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach a method

determining whether the ratio of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the macro block and another threshold value from among the set macro block splitting threshold values for determining whether to split the macro block; and

determining whether the preceding macro block has been split if the ratio is between the threshold value and the other threshold value.

However, by determining whether the ratio is greater than the threshold value for determining the possibility of splitting the macro block (and subsequently the threshold value for determining the possibility of splitting the sub block), prior to determining whether the ratio of maximum of maximum MAD to minimum MAD is less than the threshold value for determining whether to split the macro block (and subsequently for the sub block), one would thereby determine whether the ratio is in between the two thresholds. If so, then determination of whether the preceding macro block (and subsequently sub block) has been split can occur.

Boyce discloses a method comprising determining whether the ratio of maximum MAD to minimum MAD ("ratio of MAD_o /MAD_{min}" at col. 4, line 56) is greater than the threshold value ("determined value B" at col. 4, line 44) for determining the possibility of splitting the macro block ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 8**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses a method wherein determining of whether to split the macro block comprises:

determining whether the ratio of maximum of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the macro block and another threshold value from among the set splitting threshold values for determining whether to split the macro block (see rejection of claim 17),

determining whether a macro block at a same location in a preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" Pullen et al. at col. 12, line 14; "process for level 1

begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" Pullen et al. at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" Pullen et al. at col. 18, line 30) if the ratio is between the threshold value and the other threshold value (see claim 17),

determining not to split the macro block if the macro block at the same location in the preceding image frame has not been split, and determining whether to split the block if the block at the same location in the preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30; if the estimated cost is more than the distortion measurement, then the level 1 search is not performed hence not splitting the level 0 block) and the ratio is between the threshold value and the other threshold value (see rejection of claim 17).

Regarding **claim 18**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method wherein determining of whether to split the sub block into smaller sub blocks by determining whether the sub block has been split in a preceding image frame at the same location comprises:

determining a possibility of splitting the sub block ("determine whether block B_{ij} requires splitting" Mancini et al. at section 6.5.1, paragraph 3, line 6) by determining whether a ratio of maximum mean absolute difference (MAD) to minimum MAD of a sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the set sub block splitting threshold values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block,

determining whether the ratio of maximum of maximum MAD to minimum MAD is less than the threshold value for determining whether to split the sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13),

determining whether the sub block at the same location in the preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold" Pullen et al. at col. 5, line 55)if the ratio is less than the threshold value for determining whether to split the sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9),

determining not to split the sub block if the sub block at the same location in the preceding image frame has not been split and determining to split the sub block if the

sub block at the same location in the preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold. If it is greater than or equal to the threshold, no further processing of the domain child block is performed" Pullen et al. at col. 5, line 55; "If the cost for the domain child blocks is less than the domain child block error, the codes for the domain child block are included" Pullen et al. at col. 6, line 3).

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach a method

determining whether the ratio of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the sub block and another threshold value from among the set sub block splitting threshold values for determining whether to split the sub block; and

determining whether the preceding sub block has been split if the ratio is between the threshold value and the other threshold value.

However, by determining whether the ratio is greater than the threshold value for determining the possibility of splitting the sub block, prior to determining whether the ratio of maximum of maximum MAD to minimum MAD is less than the threshold value for determining whether to split the sub block, one would thereby determine whether the ratio is in between the two thresholds. If so, then determination of whether the preceding sub block has been split can occur.

Boyce discloses a method comprising determining whether the ratio of maximum MAD to minimum MAD ("ratio of MAD_o /MAD_{min}" at col. 4, line 56) is greater than the threshold value ("determined value B" at col. 4, line 44) for determining the possibility of splitting the sub block ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 9**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses a method wherein determining of whether to split the sub block comprises:

determining whether the ratio of maximum of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the sub block and another threshold value from among the set splitting threshold values for determining whether to split the sub block (see rejection of claim 18)

determining whether the sub block at a same location in a preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second

error threshold" Pullen et al. at col. 5, line 55) if the ratio is between the threshold value and the other threshold value (see rejection of claim 18).

determining not to split the block if the block at the same location in the preceding image frame has not been split, and determining whether to split the block if the block at the same location in the preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold. If it is greater than or equal to the threshold, no further processing of the domain child block is performed" Pullen et al. at col. 5, line 55) and the ratio is between the threshold value and the other threshold value (see claim 18).

Regarding **claim 30**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses an apparatus (an apparatus is inherent to carry out the function of the method) and a method of splitting a block wherein the determining whether to split the macro block into sub blocks comprises:

a macro block splitting possibility determining portion (portion of apparatus that performs algorithm of section 6.5.1) that determines whether the ratio of maximum mean absolute difference (MAD) to minimum MAD of a sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the macro block splitting threshold values ("threshold value θ_3"

Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block; and

a macro block splitting determining portion (portion of apparatus that performs algorithm of section 6.5.1) that, if a ratio is greater than the threshold for determining the possibility of splitting the macro block ("if $\Sigma \kappa_i < \theta_2$ then do not split, otherwise continue" Mancini et al. at section 6.5.1, paragraph 3, line 8; "tolerable number of outliers as a fraction of the block size" Mancini et al. at section 6.5.1, paragraph 3, line 11), determines whether to split the macro block by comparing the threshold value for determining the possibility of splitting the macro block ("Threshold θ_2" Mancini et al. at section 6.5.1, paragraph 3, line 11), and comparing the ratio of maximum MAD to minimum MAD, and a threshold value from among the macro block splitting threshold values for determining whether to split the macro block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13),

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach comparing the threshold value for determining the possibility of splitting the macro block with the ratio of maximum MAD to minimum MAD, and that the ratio greater than the threshold for determining the possibility of splitting the macro block is the ratio of maximum MAD to minimum MAD.

Boyce discloses a method comprising:

comparing the threshold value for determining the possibility of splitting the macro block ("determined value B" at col. 4, line 44) with the ratio ("ratio of MAD_o /MAD_{min}" at col. 4, line 56) of maximum MAD ("MAD_o is the mean of the absolute differences between pixels in the block in a reference frame for which noise is to be reduced and the pixels in a block having the same position in another frame" at col. 4, line 28) to minimum MAD ("The matching block is the one having the minimum value of mean absolute difference, MAD, which is MAD_{min}" at col. 4, line 34),

the ratio greater than the threshold for determining the possibility of splitting the macro block is the ratio of maximum MAD to minimum MAD ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 32**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses a method of splitting a block wherein the determining of whether to split each sub block into smaller sub blocks comprises:

a sub block splitting possibility determining portion (portion of apparatus that performs algorithm of section 6.5.1) that determines whether a ratio of maximum mean

absolute difference (MAD) to minimum MAD of the smaller sub block ("max(κ_i, i = 1,…,4)/min(κ_i, I = 1,…,4) < θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13) is greater than a threshold value from among the sub block splitting threshold values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the sub block; and

a sub block splitting determining portion (portion of apparatus that performs algorithm of section 6.5.1) that, if a ratio is greater than the threshold for determining the possibility of splitting the sub block ("if $\Sigma \kappa_i < \theta_2$ then do not split, otherwise continue" Mancini et al. at section 6.5.1, paragraph 3, line 8; "tolerable number of outliers as a fraction of the block size" Mancini et al. at section 6.5.1, paragraph 3, line 11), determines whether to split the sub block by comparing the threshold value for determining the possibility of splitting the sub block ("Threshold θ_2" Mancini et al. at section 6.5.1, paragraph 3, line 11), and comparing the ratio of maximum MAD to minimum MAD, and a threshold value from among the sub block splitting threshold values for determining whether to split the sub block ("max(κ_i, i = 1,…,4)/min(κ_i, I = 1,…,4) < θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" Mancini et al. at section 6.5.1, paragraph 3, line 13),

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not teach comparing the threshold value for determining the possibility of splitting the sub block with the ratio of maximum MAD to minimum MAD, and that the ratio greater than

the threshold for determining the possibility of splitting the sub block is the ratio of maximum MAD to minimum MAD.

Boyce discloses a method comprising:

comparing the threshold value for determining the possibility of splitting the sub block ("determined value B" at col. 4, line 44) with the ratio ("ratio of MAD_o /MAD_{min}" at col. 4, line 56) of maximum MAD ("MAD_o is the mean of the absolute differences between pixels in the block in a reference frame for which noise is to be reduced and the pixels in a block having the same position in another frame" at col. 4, line 28) to minimum MAD ("The matching block is the one having the minimum value of mean absolute difference, MAD, which is MAD_{min}" at col. 4, line 34),

the ratio greater than the threshold for determining the possibility of splitting the sub block is the ratio of maximum MAD to minimum MAD ("If the ratio of MAD_o /MAD_{min} is less than B, it is considered that the differences between the blocks are due to noise" at col. 4, line 56; consequently, if the ratio is greater than B, the differences are considerable enough to be further processed).

It would have been obvious at the time the invention was made to one of ordinary skill in the art for the threshold value of the Mancini et al., Thyagarajan et al. and Pullen et al. combination to be compared using the ratio taught by Boyce as described above, such that a block "caused by a poor motion estimate such as due to a change in scene so that it is not included" (Boyce at column 2, line 49).

Regarding **claim 34**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses an apparatus, wherein the macro block splitting determining portion comprises:

a preceding macro block splitting determiner (portion the apparatus that performs the steps of the algorithm) that determines whether the macro block at a same location in a preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" Pullen et al. at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" Pullen et al. at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" Pullen et al. at col. 18, line 30) after determining that the ratio of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the macro block and the threshold value for determining whether to split the macro block (see rejection of claim 17).

a macro block splitting final determiner (portion the apparatus that performs the steps of the algorithm) that finally determines not to split the block if the block at the same location in the preceding image frame has not been split, and determining whether to split the block if the block at the same location in the preceding image frame has been split ("find a block in previous buffer 30, a search corresponds to a block in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4;

"If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30; if the estimated cost is more than the distortion measurement, then the level 1 search is not performed hence not splitting the level 0 block).

Regarding **claim 35**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses an apparatus, wherein the sub block splitting determining portion comprises:

a preceding sub block splitting determiner (portion the apparatus that performs the steps of the algorithm) that determines whether a sub block at a same location in a preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error threshold" Pullen et al. at col. 5, line 55) after determining that the ratio of maximum of maximum MAD to minimum MAD is between the threshold value for determining the possibility of splitting the sub block and the threshold value for determining whether to split the sub block (see rejection of claim 18).

a sub block splitting final determiner (portion the apparatus that performs the steps of the algorithm) that finally determines not to split the block if the block at the same location in the preceding image frame has not been split, and determining whether to split the block if the block at the same location in the preceding image frame has been split ("distortion measurement between the domain child block and the range child block corresponding to the adjusted motion vector is compared to a second error

threshold. If it is greater than or equal to the threshold, no further processing of the domain child block is performed" Pullen et al. at col. 5, line 55).

Regarding **claim 43**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses an apparatus (an apparatus is inherent to carry out the function of the method) that performs the method as described in the rejection of claim 17 above.

Regarding **claim 44**, the Mancini et al., Thyagarajan et al., Pullen et al. and Boyce combination discloses an apparatus (an apparatus is inherent to carry out the function of the method) that performs the method as described in the rejection of claim 18 above.

Regarding **claim 53**, Mancini et al. discloses an apparatus wherein the macro block splitting determining unit comprises:

a macro block splitting possibility determiner (portion of apparatus that performs algorithm of section 6.5.1) that determines whether the ratio of maximum mean absolute difference (MAD) to minimum MAD of the sub block ("$\max(\kappa_i, i = 1,\ldots,4)/\min(\kappa_i, I = 1,\ldots,4) < \theta_3$" at section 6.5.1, paragraph 3, line 9; "ratio of the maximum to the minimum number of outliers in the four sub-blocks" at section 6.5.1, paragraph 3, line 13) in the macro block is greater than a threshold value from among the macro block splitting threshold values ("threshold value θ_3" Mancini et al. at section 6.5.1, paragraph 3, line 12) for determining the possibility of splitting the macro block.

9. Claims 54 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Mancini et al., Thyagarajan et al. and Pullen et al. as applied to claim 42 above, and further in view of common knowledge in the art.

Regarding **claim 54**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses the elements of claim 42 as shown in the 103 rejection above.

The Mancini et al., Thyagarajan et al. and Pullen et al. combination does not explicitly disclose

determining that the ratio of maximum to minimum MAD is between the threshold value for determining the possibility of splitting the macro block and a threshold value for determining whether to split the macro block.

However, by determining whether the ratio is greater than the threshold value for determining the possibility of splitting the macro block (and subsequently the threshold value for determining the possibility of splitting the sub block), prior to determining whether the ratio of maximum of maximum MAD to minimum MAD is less than the threshold value for determining whether to split the macro block (and subsequently for the sub block), one would thereby determine whether the ratio is in between the two thresholds. If so, then determination of whether the preceding macro block (and subsequently sub block) has been split can occur.

Regarding **claim 55**, the Mancini et al., Thyagarajan et al. and Pullen et al. combination discloses determining not to split the macro block if the preceding macro block has not been split and determining to split the macro block if the preceding macro block has been split ("find a block in previous buffer 30, a search corresponds to a block

in current frame buffer 16" at col. 12, line 14; "process for level 1 begins by segmenting the level 0 domain block in to a plurality of level 1 domain child blocks" at col. 18, line 4; "If the estimated cost is less than the distortion measurement, a level 1 range area is defined in the previous frame buffer for one of the domain child blocks and each range child block within that range area is compared to the domain child block" at col. 18, line 30; if the estimated cost is more than the distortion measurement, then the level 1 search is not performed hence not splitting the level 0 block).

Response to Arguments

Summary of Remarks (@ response page labeled 18): The Pullen reference does not disclose "determining thereby whether to split the macro block into sub blocks by determining whether the macro block at the same location in a preceding image frame has been split".

Examiner's Response: Pullen describes a preliminary segmentation of the level 0 domain block in to level 1 blocks. An associated distortion measurement is carried out for each level 1 block. For a level 1 block that has too much distortion, it is established that there is no level 1 range area in the previous frame (same location in a preceding image frame), which means the previous frame does not contain a corresponding level

1 block, indicating it has not been split. As a result, the level 1 search is not performed and the level 0 domain block is not split.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KATRINA FUJITA whose telephone number is (571)270-1574. The examiner can normally be reached on M-Th 8-5:30pm, F 8-4:30pm.

11. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Werner can be reached on (571) 272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Katrina Fujita/
Examiner, Art Unit 2624
/Brian P. Werner/
Supervisory Patent Examiner, Art Unit 2624